Waste from Food Industry and their Disposal: Some Facts

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***Abstract*-Due to increasing industrialization quantity of waste water is increasing at alarming rate while compositions of such waste are being more and more complex. Disposal of such waste must follow suitable treatments so that qualities of effluent for disposal follow requisite standards. Such Standards for effluent are discussed and a case study for a beverage producing plant is reported.**

***Index Terms*-industrial waste, eco-friendly disposal, effluent standards, law enforcement, waste minimization.**

I. INTRODUCTION

All industries are based on appropriate technologies to transform basic raw materials to finished products with the help of additional components like power. However it is unfortunate that there is hardly any industry where all raw materials are changed to finished products only but there are always some left over materials which may be solid, liquid or gaseous, generally unusable and harmful and require continuous disposal. Such disposals are generally perpetual and problem-some causing stresses on resources and health of the country. These left-overs are generally referred as industrial waste which requires cost-effective and eco-friendly disposals to maintain the environment unaffected if not better for future mankind. The awareness to keep the environment friendly was not felt from earlier days because of meagerness of industries in those days. But rate of increasing growth of industries from early twentieth century and their accumulated effects have been the cause of extinction of many natural species and fauna and are accused as generator of greenhouse effect leading to dangerous situation for existing world. Fortunately the graveness for the situation is understood in the present day world and concerted efforts are being made by nations of the world on agreed common policies under United Nations. To investigate the state of affairs for disposal of industrial waste in the Food Industries around Kolkata a study was undertaken to examine the raw effluents from the Industry under study, in laboratory to determine the quality of such effluents and also that of the final effluents left by the Industry for disposal. Comparison was made between the observed values from actual measurements and the permissible values as specified by controlling body.

II. INDUSTRIAL WASTE FROM FOOD INDUSTRIES

Industrial waste from food industries varies with the type of food industry, quality and nature of raw material used, nature of the adopted manufacturing process etc. It is to be noted that the composition of industrial wastewater varies not only from industry to industry but also among the same industries. The constituents of industrial wastewater are organic matter (biodegradable and non-biodegradable), suspended solids, acids and alkalies, inorganic salts, floating solids, heated water, color, toxic substances, microorganisms, radioactive wastes, foam producing substances etc. [1]

An excellent summary of produced industrial waste from different food industries has been presented by Pandey et al.[3] Industrial wastes in above industries consist generally of the followings: -

a. Effluent obtained from various Industrial processes,
b. Industrial Floor washing,
c. Condensate water and,
d. Sanitary faccal waste.

As the process involved, raw material used and end products achieved vary from industry to industry and therefore each industry are required to choose the best treatment methods for their works through proper study. However it is not always necessary to treat the entire industrial waste. Some in-plant measures may be adopted to reduce or even eliminate the harmful matters.

III. PRETREATMENT OF INDUSTRIAL WASTE

To reduce the time, cost and improve the efficiency of the adopted methods of treatment of the industrial waste several pre-treatment methods have been suggested by different workers.

Following methods individually or in combination may be adopted for pre treatment purposes -

i. Use of soft detergents, instead of hard detergents for eliminating the foam nuisance. This is known as 'process change.[4]
ii. Recovery of silver from photographic wastes, which provides a primary treatment. It is known as recovery of material.[5]
iii. Refuse of water in industrial processes, such as collecting cooling water from boilers, eliminating its heat and reusing it.[2]
iv. Mixing acidic and alkaline wastes together, for

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neutralizing each other and making the mixture more nearer to the normal value of pH. This process is known as mixing of trade wastes.[6]

IV. EFFLUENTS STANDARD FOR DISPOSAL

Different standards in various countries, particularly for developed countries, have been developed over some time and are in use so that such effluents do not cause significant harm after disposal on environment and being updated from time to time after systematic study on the efficacy of adopted measures. Stringent following of such norms are being enforced through legal controlling agencies. The rapid industrialization in India has also led to introduce permissible limits of standards for industrial effluents. Central Pollution Control Board and State Pollution Control Boards are established in India to do the needful policing in this arena. The effluents after proper treatment can be allowed for discharge to

a. Streams or water courses,
b. Land for irrigation purposes and
c. Public sewer

The relevant limits as per adopted course in India are summarized below.

A. When industrial effluents are allowed for disposal into water courses IS 2940:1963[7] demands

i. In exceptional cases the BOD may be allowed upto 100mg/l.
ii. As far as possible, and practicable, it should be free from color and unpleasant odors.
iii. Its pH vale should be between 5.5 to 9.0.
iv. From the outlet upto 15m downstream, the temperature should not be more than 40°C in any section of the stream.
v. Oil, grease, phenolic compounds cyanides (as CN) sulphides (as S) should not exceed 10.0, 1.0, 0.2 and 2.0 mg/l respectively.
vi. Total suspended solids should not exceed 100 mg/l.
vii. Presence of arsenic, cadmium, barium, chromium, copper, mercury, lead, selenium, nickel, silver and zinc should not exceed 1.0 mg/l individually or collectively, and
viii. Total residue chlorine and fluorides as (F) should not exceed 1.0 and 2 mg/l respectively,

B. When Industrial effluents are discharge on land for irrigation purposes.IS 3307:1965[8] demands

i. The total dissolved inorganic solids should not exceed 2100 mg/l,
ii. 5-day BOD at 20°C, should not exceed 500 mg/l,
iii. pH-value of effluent should be between 5.5 to 9.0,
iv. Quantity of sulphates and grease should not be more than 30 mg/l, and
v. Quantity of boron should not exceed 2 mg/l.

C. When Industrial effluents are discharge to public sewer IS 3306:1965[9] demands

i. Its pH- value should be between 5.5 to 9.0,
ii. 5-day BOD at 20°C should be between 5.5 to 9.0,
iii. Lead, copper and zinc should not exceed 1.0, 3 and 15 mg/l respectively,
iv. Effluent temperature should not exceed 45°C
v. Quantity of suspended solids should not exceed 6900 mg/l,
vi. Chromium, nickel and cyanide should not exceed 2% each,
vii. Effluent containing solids, such as straw, plastic, wood, paint residue, gross solids from cannery wastes, cinder, ash, sand, tar, rag, hair, metal shavings, garbage, broken glass etc., should not be discharged into public sewers.
viii. Phenolic compounds, sulphates and total inorganic dissolved solids should not exceed 51,000 and 2100 mg/l, respectively
ix. Suspended solids should not exceed 600 mg/l,
x. Chloride and boron should not exceed 600 and 2 mg/l respectively.

V. LAW ENFORCEMENT

The Central Pollution Control Board (CPCB) is the national apex body for assessment, monitoring and control of waste pollution. The executive responsibilities for enforcement of the Acts for Prevention and Control of Pollution of Water (1974) and of the Water (Cess) Act, 1977 are carried out through the board. Under the Environment (Protection) Act, 1986, effluent and emission standards in respect of 61 categories of industries have been notified. As per Pollution Control Law(Series: PCLS/4/2000-2001) the Food & Fruit Processing Industries Wastewater Discharge Standards are given in Table I - State pollution control boards are formed to enforce the law constituted by central and state governments at state level. (Kaul,2005).

TABLE I
WASTE WATER DISCHARGE STANDARD FOR FOOD AND FRUIT PROCESSIONG INDUSTRIES IN INDIA

Category		*Concentration not to exceed*			
		pH	*Suspended Solids (mg/l)*	*Oil & Grease (mg/l)*	*BOD at 27°C for 3 days (mg/l)*
A.	*Soft drinks*				
a.	*Fruit based/synthetic (more than 0.4 tonne/day) Bottles and tetra pack*	*6.5-8.5*	*100*	*10*	*30*
b.	*Synthetic (<0.4 tonne/day)*	*Disposal via septic tank*			
B.	*Fruits & Vegetables*				
a.	*Above 0.4 tonne/day*	*6.5-8.5*	*50*	*10*	*30*
b.	*0.1-0.4 tonne/day*	*6.5-8.5*	-	-	*300**

VI. PRESENT SCENARIO IN INDIA

Industrial growth in India took place after the liberalization of Indian economy in 1991. To focus on Industrial pollution the Government of India has identified 19 critically

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polluted areas in the country and 17 industrial sub-sectors which are polluting namely, cement, thermal power plant, distilleries, sugar, fertilizer, integrated iron and steel, oil refineries, pulp and paper, petrochemicals, pesticides, tanneries, basic drugs and pharmaceuticals, dye and dye intermediates, caustic soda, zinc, smelter, copper smelter and aluminum smelter. The list of critically polluted area is given in Table II.Out of a total of 1,551 units identified under these categories by Central Pollution Control Board(CPCB) 1,259 units have installed adequate facilities for pollution control 112 units have been closed down and remaining are putting the polluting control schemes. Since November 1991, World Bank with Ministry of Environment and forests, Government of India(MoEF) is providing finance for pollution control projects to individual industrial units for pollution prevention and control. The funds are disbursed by Industrial Development Bank of India (IDBI) and the Industrial Credit and Investment Corporation of India Limited (ICICI). From the credit line of the World Bank nearly 610 units have taken loans amounting to more than 90 million US dollars. In view of such positive response from Industry, Government of India has recently negotiated second line under Industrial Pollution Prevention Project where similar funds would again be available. In the case of new units, the cost of pollution control is internationalized with the entire project cost and is financed within the overall financing package of entire project. In general, the cost is less than 5% of the

TABLE II.
CRITICALLY POLLUTED AREAS(AFTER KAUL, 2005)[10]

Sl. No.	State	Area
1.	Punjab	Mandi Gobindgarh
2.	Rajasthan	Pali
3.	Delhi	Najafgarh Drain Basin
4.	Gujarat	Vapi
5.	U.P.	Singhrauli
6.	Bihar	Dhanbad
7.	West Bengal	Durgapur
8.	West Bengal	Howrah
9.	Orissa	Talcher
10.	Tamil Nadu	North Arcot
11.	Tamil Nadu	Manali
12.	M.P.	Korba
13.	Assam	Digboi
14.	Maharashtra	Chembur
15.	A.P.	Vishakapatnam
16.	Karnataka	Bhadravati
17.	Kerala	Greater Cochin Area
18.	Himachal Pradesh	Kala-Amb
19.	Himachal Pradesh	Parwanaoo

total capital cost of the project except for specific industry sub-sectors where the cost may be as high as 10 %. Effective enforcement of environment legislation, increased public awareness and change in industry's perception of its social responsibility have resulted in significant increase in compliance to the various provisions of environmental legislation in the large and medium scale industries.

VII. MEASURED QUALITY OF WASTE WATER BEFORE AND AFTER DISPOSAL IN A TYPICAL BEVERAGE INDUSTRY IN KOLKATA

Wastewater generated from food industries has distinctive characteristics that set it apart from common waste waters managed by public or private waste water treatment plants throughout the world which can have adverse environmental effect on air and water quality as well as producing toxic side products. To examine the nature of effluent produced in food industries, correctness of adopted treatment process and finally to check the characters of the treated effluents at the time of disposal, a detailed study has been made in a typical non-alcoholic beverage production unit in West Bengal, manufacturing 445 tons of soft drinks daily.

TABLE III.
QUALITY MONITORING OF DIFFERENT WASTE WATERSOURCES

Products	Daily generate m^3/hr	pH	TSS mg/L	COD mg/L	BOD_5 mg/L	Oil and Grease mg/L
R6B/CSD	12	10-12	80-100	1000-1200	60-80	2-7
PET	5	6-8	60-80	200-400	40-60	2-5
Fruit Drinks R6B	8	6-10	100-120	1500-2000	120-150	5-7
Fruit Drinks Tetra Pack	3	6-8	50-60	500-700	50-80	5-7
Water Treatment Plant	10	6.5-7.5	60-80	200-500	20-40	5-7

Details of the arrangement are explained elsewhere. [11]

Experiments conducted on the samples of wastewater collected from the five basic sources of waste water viz. returnable glass bottle/carbonated soft drinks production, PET (poly ethylene terephthalate) production, fruit juice RGB production, fruit juice tetra pack production and from water treatment plant of back washing units were examined in details and comparison was made from the observed values from actual measurements with permissible values as specified by the controlling agencies in the country. All test runs were conducted with affixed cycle time of 8 hr and with a fixed fill time of 1 hr. The fill phase was under anoxic conditions for all runs, without any aeration or mixing. For the react time of 4.5 hr, tested in the study, biodegradable COD (Chemical Oxygen Demand) removal efficiency of more than 90% was achieved at influent. Wastewater characterization indicates generation of wastewater from Fruit juice RGB section that can be classified as strong nature, having total COD of 1500 mg/l and which is due to elevated organic matter content. The wastewater characterization of segregate wastewater streams originating from each source is given in Table III. The most arresting feature of the high organic content of two wastewater sources, RGB/CSD and fruit drinks are noticeable. Rest streams are having lower COD values indicating no need

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of any treatment and in-plant control measure could be adopted by rejecting means.

TABLE IV.
QUALITY MONITORING OF TREATED WATER

	Standard values	Values at ETP outlets
pH	6.5-8.5	7.5
TSS	100 mg/l	20
COD	150 mg/l	40
BOD	30 mg/l	20
O&O	10 mg/l	<1
Cadmium	2.0 mg/l	Minimal
Lead	0.1 mg/l	Minimal

Further, the final effluent before disposal was tested and results with their limiting values are given in Table-

CONCLUSIONS

On the basis of the study following conclusions may be made

[1] In the beverage plant under study, systematic and regular periodical testing are made to check the quality of effluents.

[2] The test results of different parameters from the conducted experiments on samples of wastewater collected from discharge points indicate values much lesser than the permissible limits set by controlling environmental agencies

[3] The importance of in-plant control or reuse (e.g. sugar recovery and reuse) is emphasized. In case of waste water with large amount of organic matter, an effective end of pipe treatment (anaerobic treatment or membrane processes) may be needed adding some additional financial burden to the industries.

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